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Through the Lens of Investment Anomalies: Profitable Investment Strategies Throughout Business Cycles

UNDERGRADUATE RESEARCH THESIS

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Abstract

Market efficiency is a topic that has been thoroughly questioned and examined by various economists and market strategists. Market efficiency has been challenged, as anomaly research has exposed its limitations within the investment process. Economists and researchers continue to study the puzzling nature of asset pricing anomalies and examine various factors' predictive power in understanding where these anomalies come from and how they impact securities' performance over time. The purpose of this study is to further examine asset price anomalies, the development of investment strategies, and the success of each investment strategy throughout economic upward and downward trends. The methodology includes: identifying anomaly factors that have proven their ability to generate excess returns above the market, creating investment portfolios that mimic each investment strategy, and analyzing the relationship between the anomaly signal and the firm's total return over time, specifically throughout varying stages of a business cycle. The anomaly variables tested include: momentum, value-versus-growth, investment, profitability, intangibles, and trading frictions, all of which were examined across three definitive time periods: pre-financial crisis (2000-2006), the financial crisis (2007-2008), and post financial crisis (2009-2013). The results of the analysis indicate that there is statistically significant evidence that there are factors linked to investment strategies that produce abnormal returns specific to each sample period. In other words, based upon the research provided in this study, conclusions can be made about the relationship between economic conditions and effectiveness of investment strategies and about market efficiency itself. The understanding of anomalies and those factors that influence them are important to investors, as they seek to generate positive returns on their assets. More importantly, the ability to comprehend how markets function, anticipate market outcomes, and formulate fruitful investment strategies is powerful for not only investors, but also for the economic systems across the globe.

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INTRODUCTION

Market efficiency is a topic that has been thoroughly questioned and examined by various economists and market strategists. American economists Harry Roberts and Eugene Fama formally posed the question, "Can anyone consistently beat the market?", classifying market efficiency into three forms: weak form, semi-strong form, and strong form. Each form is derived from a particular set of information: weak form is based upon the assumption that historical pricing data is unable to be used to predict securities' future prices and/or returns; semi-strong form implies that public information has no effect on predicting securities' future performance; and strong form indicates that private information is unable to be used to outperform the market. Since the inception of the efficient market hypothesis, there has been widespread research and debate in regards to the validity of Fama's and Robert's proposition (Zacks, 2011).

Market efficiency has been challenged, as anomaly research has exposed its limitations within the investment process. Much of this anomaly research has led to the formulation of multifactor models that have consistently produced positive risk adjusted returns (Zacks, 2011). Significant empirical models such as the 'CAPM Model', 'Fama and French 3- Factor Model,' and the 'Carhart Four Factor Model' have been used to explain the variation across asset pricing, and thus security and portfolio returns that cannot be explained by the efficient market hypothesis.

Additionally, economists and researchers continue to study the puzzling nature of asset pricing anomalies and examine various factors' predictive power in understanding where these anomalies come from. The understanding of anomalies and those factors that influence them are important to investors, as they seek to generate positive returns on their assets. More importantly,

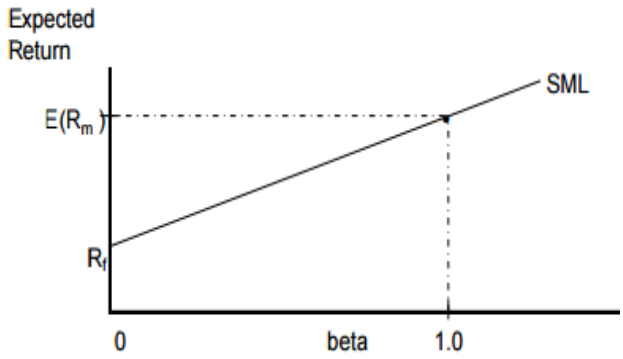
the ability to comprehend how markets function, anticipate market outcomes, and formulate fruitful investment strategies is powerful for not only investors, but also for the economic systems across the globe.

LITERATURE REVIEW

Over the past several decades, several multifactor models have been developed and examined to understand the relationship between risk and reward and those factors that influence assets' expected return apart from systematic market risk. In other words, economists and investors have continued to identify inefficiencies in the market that have led to asset pricing anomalies (Zacks, 2011). Some of the most influential multifactor models that have guided investors through the investment process and have proven successful at generating positive returns include: the CAPM Model, the Fama & French 3-Factor Model, and the Carhart Four Factor Model.

The CAPM Model is based on several key assumptions and attempts to quantify the relationship between risk, which is assumed to be represented by beta, and the expected return of a given security. The model assumes that investors: always seek to maximize their expected return based upon expected risk, believe in market risk/reward tradeoffs, and choose to hold diversified portfolios. The CAPM draws a relationship between assets' expected returns and the level of market risk to which they are exposed through the equation: $E(r_A) = r_f + \beta_A(E(r_m) - r_f)$, where r_f is the risk-free rate, β_A is the corresponding measure of risk related to the asset, and $(E(r_m) - r_f)$ is the market risk premium, or the excess return of the market portfolio. In other words, the CAPM indicates that an asset's ability to generate an expected return beyond the risk-free rate and above the market is purely dependent upon the asset's beta. This relationship

between expected return and beta can be graphically depicted via the Security Market Line, shown below (Womack, 2003):



(Womack, 2003)

Although the CAPM has proved to be a powerful tool for investors, it does have its limitations. According to "Understanding Risk and Return, the CAPM, and the Fama-French Three-Factor Model", written by Kent Womack, "The CAPM models usually achieve an R^2 measure of only about 0.85. While this relatively high R^2 value is one of the main reasons for the popularity of the CAPM, it also highlights the fact that roughly 15% of the variation in observed returns still remains unexplained" (Womack, 2003). Despite its weaknesses, the CAPM Model has served as an important framework for investors and has laid the foundation for more complex multifactor models.

The Fama & French 3-Factor Model builds upon the CAPM Model, proposing additional significant factors in explaining realized returns of securities' apart from market risk. Fama and French concluded that factors encompassing "value" and "size" are important determinates of securities' expected returns and must be accounted for. In order to represent the risks associated with value and size, Fama and French introduced the SMB (Small Minus Big) and HML (High Minus Low) Factors. The SMB Factor measures the excess return that relatively small market capitalization firms generate for their investors; this excess return is also known as the "size premium". The HML Factor measures the excess return that relatively high book-to-market firms

generate for their investors; this excess return is also known as the "value premium". Adding both the size premium and value premium to the market risk factor postulated by the CAPM, this 3-Factor Model draws a relationship between an assets' expected return and market, size, and value risk. This relationship is described through the following equation: $E(r_A) = r_f + \beta_A(E(r_m) - r_f) + s_A SMB + h_A HML$, where r_f is the risk-free rate, β_A is the corresponding measure of risk related to the asset, $(E(r_m) - r_f)$ is the market risk premium, s_A is the measure of size risk exposure, and h_A is the measure of value risk exposure. The SMB and HML Factors have grown in popularity amongst investors, as their predictive power has proven to be successful time and time again (Womack, 2003). That said, this model is still thoroughly examined, as researchers continue to identify additional significant factors with great predictive power outside of market risk, size risk, and value risk. Evidence has shown that the Fama & French 3-Factor Model fail to account for several other asset pricing anomalies (Hou, Xue, Zhang, 2014).

Using both the CAPM and Fama & French 3-Factor Model as a framework, the Carhart Four-Factor model was developed. The Carhart Four-Factor Model incorporates market, size, and value risk, but also includes a momentum factor as a risk variable. This momentum factor is described as Up Minus Down, or UMD, and indicates that those securities that have consistently increased in price, and thus generated a positive return, will continue to do so. Researchers have related this factor to the "bandwagon effect"—as investors see a security increasing in price, they react quickly to purchase that security and others follow suit. This factor incorporates yet another asset pricing anomaly apart from size and value premiums, and further contradicts market efficiency ("Zacks Investment Research: Equity Market Anomalies for August 18, 2011", 2011).

The CAPM Model, the Fama & French 3-Factor Model, and the Carhart Four-Factor Model have served as useful tools for investors, while continuing to challenge the efficient

market hypothesis. However, these empirical models have various limitations and fail to account for a wide array of asset pricing anomalies. Investors continuously seek to understand these anomaly variables that impact security and portfolio returns, and it is clear that the varying asset prices across several different factors have yet to be totally explained. More importantly, the optimal investment approach has yet to be identified (Hou, Xue, Zhang, 2014).

PURPOSE

My research stems from the research and publication of "Digesting Anomalies: An Investment Approach," written by Kewei Hou, a professor at The Ohio State University and China Academy of Financial Research, Chen Xue, a professor at the University of Cincinnati, and Lu Zhang, a professor at The Ohio State University and National Bureau of Economic Research. This publication revolves around: the explanation of the shortcomings of established factors models that attempt to explain asset pricing anomalies, the proposition of an additional model called the 'q-factor model' that further attempts to capture additional explanation of differences in asset pricing and returns, and conclusions that these authors drew as it relates to a list of over eighty different anomaly variables. These anomaly variables studied in the development of the "q-factor model" were tested for significance in terms of a return spread over a span of approximately sixty years (Hou, Xue, Zhang, 2014).

The purpose of this study is to further examine asset price anomalies, the development of investment strategies, and the success of each investment strategy throughout economic upward and downward trends. By analyzing a set of anomaly variables, particularly amongst those that resulted in statistical significance in terms of a return spread across three definitive time periods: pre-financial crisis (2000-2006), the financial crisis (2007-2008), and post financial crisis (2009-

2013), the effectiveness of these investment strategies across varying economic conditions can be understood. Additionally, conclusions can be drawn about whether or not these investment approach or approaches are more profitable depending on the business cycle. Finally, it is important to fully uncover the long-term implications of the various business cycles, specifically economic downturns, as it relates to investment strategies.

HYPOTHESIS

I selected a particular set of anomaly variables that have consistently appeared in various investment strategies, specifically amongst those that resulted in statistical significance in terms of a return spread. The anomaly variables that I have selected to test include:

Table 1:

Investment Strategy	Factor
Momentum	Price Momentum
Value-versus-growth	Book-to-Market Equity
Investment	Investment-to-assets, Net Operating Assets, & Operating Accruals
Profitability	Return on Equity
Intangibles	R&D-to-Market
Trading Frictions	Market Equity

Using these variables, I will test these anomalies across three definitive time periods: pre-financial crisis (2000-2006), the financial crisis (2007-2008), and post financial crisis (2009-

2013). I anticipate that I will obtain the following results as it relates to the anomalies listed above:

1. **Momentum: Price Momentum**

   There is strong evidence that shows that over time those securities that are experiencing an increase in stock price continue to do so in the long run due to a "bandwagon effect". This effect also works in the opposite direction, meaning that those securities that are experiencing a decrease in stock price continue to do so in the long run. Further evidence suggests that portfolios invested in momentum stocks experience significant returns, but with these highly positive returns comes a great amount of volatility ("Zacks Investment Research: Equity Market Anomalies for August 18, 2011," 2011). Therefore, I predict that this anomaly will hold true in the long run across the three distinct periods that I intend to test. However, I expect varying results during each period because of the level of volatility associated with momentum stocks.

2. **Value-versus growth: Book-to-Market Equity**

   Historical performance shows that value stocks typically outperform growth stocks in the long run. However, during times of economic uncertainty, growth stocks are more favorable, and thus generate higher returns that value stocks because 'growth' implies that the company is still increasingly generating revenue despite economic conditions. Moreover, during times of economic stability, value stocks redeem their favorability because of their strong fundamentals ("Zacks Investment Research: Equity Market Anomalies for June 24, 2011," 2011). Based on this evidence, I predict that value stocks outperformed growth stocks leading up to the financial crisis. During the financial crisis, I would expect that growth

stocks generated higher returns than value stocks. Finally, during the post-financial crisis, I predict that growth stocks continued to outperform value stocks for some time due to a lack of investor confidence in the market.

3. Investment: Investment-to-assets, Net Operating Assets, and Operating Accruals

Historical data suggests that those firms with low investment factors (i.e. investment-to-asset ratio, Net Operating Assets, and Operating Accruals) outperform those firms with high investment factors in the long run. The intuition behind this emphasized by Fama and French is that "accruals and investment co-vary with rational variation in expected stock returns: a lower cost of equity should naturally lead to more investment" (Resutek & Lewellen, 2016). In other words, a lower cost of equity, which implies lower expected returns, is related to higher levels of investment. Moreover, I expect that leading up to the financial crisis when there was a higher cost of equity, implying higher expected returns, firms with low investment factors outperformed those firms with high investment factors; likewise, I believe this to also be true during the time period following the financial crisis. However, I predict that during the financial crisis, firms with high investment factors outperformed those firms with low investment factors because high investment factors may have been a result of a more financially sound company that was still growing despite economic conditions.

4. Profitability: Return on Equity

There is strong evidence that shows that in the long run, firms with high returns on equity outperform those firms with low returns on equity. The intuition behind this anomaly is best

explained in the article, *NBER Reporter 2014 Number 1: Research Summary- Exploring Asset Pricing Anomalies*, written by Lu Zhang:

> All else equal, high expected returns, which translate into high costs of capital, imply low NPVs of new capital and therefore low investment; low expected returns imply high NPVs of new capital and therefore high investment. In addition, high ROE relative to low investment must imply high costs of capital, which are necessary to offset the high ROE to induce low NPVs for new capital and therefore low investment. Conversely, low ROE relative to high investment must imply low costs of capital, which are necessary to offset the low ROE to induce high NPVs for new capital and therefore high investment (Zhang 2014).

Therefore, I predict that throughout the three distinct time periods that I will be testing, those firms with high returns on equity outperformed those firms with low returns on equity every time. I do not expect that this factor will vary between business cycles because it is a direct measure of a firm's profitability.

5. Intangibles: R&D-to-Market

Those firms that invest in R&D are financially constrained because the capital tied up in R&D projects is relatively inflexible. Therefore, there is a subsequent level of risk associated with firms who invest moderately or heavily in R&D (Li, 2011). However, in the long run those firms that do invest in R&D generate higher returns than those firms that do not invest in R&D (Hou, Xue, Zhang, 2014). Therefore, I predict that leading up to the financial crisis, those firms investing in R&D generated higher returns than those that didn't because investors would have assumed the subsequent level of risk given the relatively stable

economic conditions. However, during the financial crisis and into the post-financial crisis period, I expect that R&D intensive firms underperformed compared to less R&D intensive firms because investors were more risk averse given the lack of uncertainty during these time periods.

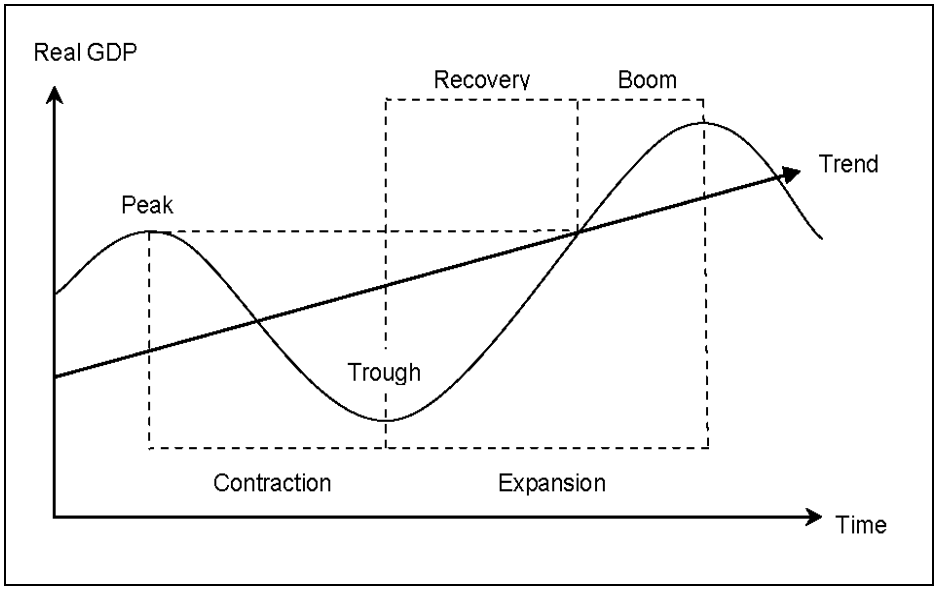
6. Trading Frictions: Market Equity

Evidence shows that in the long-run small market capitalization firms outperform large market capitalization firms. However, additional evidence shows that during times of uncertainty, such as during a financial crisis, large cap firms outperform small cap firms because investors believe there to be less risk associated with large cap firms ("Zacks Investment Research: Equity Market Anomalies for July 28, 2011," 2011). Therefore, I predict that leading up to the financial crisis, there will be a significant spread between small cap firms and large cap firms, with small capitalization firms outperforming the large capitalization firms. However, during the financial crisis, I anticipate that this anomaly will experience a reversal and large cap firms will outperform small cap firms due to a lack of the perceived level of risk associated with large cap firms. Finally, during the post-financial crisis period, I expect that small cap firms will ultimately trump large cap firms with higher returns, as the level of uncertainty diminishes.

METHODOLOGY

My research began with selecting particular criteria or "signals" that proved to be statistically significant in generating abnormal returns over the past several decades. I ultimately chose eight anomalies that I hypothesized would show predictive power across the most recent business cycle, and more specifically, anomalies that I believed would vary within the business

cycle sample periods that I had defined. Again, these sample periods include: a contractionary period prior to the great recession (2000-2006), the financial crisis itself (2007-2009), and the recovery period (2010-2013). These economic cycles are depicted in the graph below.



(Womack, 2003)

I was then able to collect secondary, firm-level data on a monthly basis for all public firms on domestic exchanges. For each factor, I separated the firms into quintiles and found the average monthly, abnormal returns for each group. Then, I found the difference between these monthly averages of the extreme quintile groups. Thus, I created a distinct portfolio for each factor that represented the difference in average monthly, abnormal returns between the two extreme quintiles for all months within 2000-2013. The differences in average monthly returns were calculated for each portfolio were calculated as follows:

1. Price Momentum: (highest quintile – lowest quintile)
2. Book-to-Market Equity: (highest quintile – lowest quintile)
3. Investment-to-assets: (lowest quintile – highest quintile)
4. Net Operating Assets: (lowest quintile – highest quintile)

5. Operating Accruals: (lowest quintile – highest quintile)
6. Return on Equity: (highest quintile – lowest quintile)
7. R&D-to-Market: (highest quintile – lowest quintile)
8. Market Equity: (lowest quintile – highest quintile)

After creating these portfolios, for each factor, I found the population mean of the entire time period as well as the sample means for each sample period that I was evaluating. I also calculated the t-stat for the entire population and sample populations to test for significance at a 10% level. Finally, I identified those strategies that showed statistical significance over the entire business cycle and/or within a particular sample period, which allowed me to draw my conclusions.

RESULTS

The results of this study were quite fascinating and carry several implications. The table below shows the summary of abnormal returns categorized by each factor.

Table 2:

Book to Market				
Sample Period	2000-2006	2007-2009	2010-2013	2000-2013
Average Abnormal Return (%)	1.907142857	0.360833333	0.384791667	1.140833333
Standard Deviation	5.206470389	5.010231961	3.090196571	4.693638224
n	84	36	48	168
t-stat	3.357217405	0.432115722	0.86270074	3.150411114
Investment to Assets				
Sample Period	2000-2006	2007-2009	2010-2013	2000-2013
Average Abnormal Return (%)	1.350238095	-0.603888889	0.459375	0.676964286
Standard Deviation	4.648256566	3.164964699	2.58301276	3.908877679
n	84	36	48	168
t-stat	2.662317878	-1.144825829	1.232143878	2.244751746
Market Equity				
Sample Period	2000-2006	2007-2009	2010-2013	2000-2013
Average Abnormal Return (%)	1.795952381	-0.211666667	0.288541667	0.935059524
Standard Deviation	7.171779386	4.772894824	3.25066801	5.832715307
n	84	36	48	168
t-stat	2.295131316	-0.266085897	0.614973692	2.077892711
Net Operating Assets				

Sample Period	2000-2006	2007-2009	2010-2013	2000-2013
Average Abnormal Return (%)	0.690119048	0.139444444	0.125625	0.410833333
Standard Deviation	3.632479154	3.121457053	2.202814357	3.168965284
n	84	36	48	168
t-stat	1.741247583	0.268037219	0.395110704	1.680361926
Operating Accruals				
Sample Period	2000-2006	2007-2009	2010-2013	2000-2013
Average Abnormal Return (%)	-0.088214286	0.695277778	-0.263125	0.029702381
Standard Deviation	3.383101935	2.239273799	3.206001789	3.119448865
n	84	36	48	168
t-stat	-0.238981059	1.862955155	-0.568615863	0.123415025
Momentum				
Sample Period	2000-2006	2007-2009	2010-2013	2000-2013
Average Abnormal Return (%)	0.296071429	-1.053055556	0.804166667	0.152142857
Standard Deviation	9.670625255	12.80284882	4.69138406	9.37701465
n	84	36	48	168
t-stat	0.280596073	-0.493509954	1.18758772	0.210301134
R&D-to-Market				
Sample Period	2000-2006	2007-2009	2010-2013	2000-2013
Average Abnormal Return (%)	0.51702381	0.485277778	0.29875	0.447857143
Standard Deviation	7.346712367	5.661521432	2.705327781	5.96580625
n	84	36	48	168
t-stat	0.64499619	0.514290496	0.765083155	0.973027246
ROE				
Sample Period	2000-2006	2007-2009	2010-2013	2000-2013
Average Abnormal Return (%)	1.023214286	0.787777778	-0.033125	0.670952381
Standard Deviation	8.488113895	5.321811049	3.232703997	6.692856821
n	84	36	48	168
t-stat	1.104828935	0.888168825	-0.070992189	1.299375892

As shown in the results summary, during the pre-financial crisis (2000-2006), my analysis demonstrated that the factors including: book-to-market, investment-to-assets, market equity, and net operating assets proved to be statistically significant in generating positive abnormal returns during this period (1.907%, 1.350%, 1.796%, .6901%, respectively). During the financial crisis (2007-2009), the only factor that showed a statistically significant result was operating accruals, producing a positive abnormal return of .6953%. Finally, during the post-financial crisis, my analysis did not exhibit any statistically significant evidence linking those factors tested and abnormal returns.

Furthermore, looking at the entire business cycle, factors including: book-to-market, investment-to-assets, market equity, and net operating assets showed statically significant evidence in generating excess returns from 2000 to 2013 (1.141%, .6770%, .9351%, .4108%, respectively). Interestingly enough, although operating accruals showed statistically significant evidence in producing positive abnormal returns during the financial crisis, it did not prove to be statistically significant over the entire business cycle. In comparing the results of the entire business cycle to the results of the individual sample periods, I was able uncover several key findings related to these anomalies and draw various conclusions.

CONCLUSIONS

Based off of the results of my study I was able to form several powerful conclusions. Most importantly, there is significant evidence (at a 10% level) that markets are not completely efficient. In other words, six out of eight of these market anomalies generated abnormal returns during this particular business cycle. If markets were efficient, there could not be statistically significant evidence that abnormal returns were linked to these various factors.

Furthermore, it is obvious that investment strategies' and their associated signals' effectiveness are linked to economic conditions. This study demonstrated that depending on where the economy is at in a business cycle, an investment strategy's success may change (positively or negatively). This can be inferred by the fact that not all of the factors analyzed of which showed statistically significant evidence of generating excess returns did so in every sample period.

Additionally, it is clear that the time horizon impacted asset pricing anomalies, as the results indicate that over a longer time horizon the anomalies are more significant, and in most

cases more profitable (generate a higher abnormal return). For instance, the pre-financial crisis period (2000-2006) was the longest sample period tested, and showed more statistically significant evidence. Likewise, over the entire sample period, several of the factors proved to be statistically significant evidence as well. That said, more research must to be done to understand the relationship between each factor and various time horizons.

More specifically, my results were telling in terms of which investment strategies may prove to be profitable during various economic cycles and across an entire business cycle. Furthermore, my analysis shows that leading up to the financial crisis, factors including: book-to-market, investment-to-assets, market equity, and net operating assets, proved to return a positive excess return above the market. This indicates that investing in a portfolio of value stocks, or stocks with high book-to-market ratios, will produce abnormal returns during a contractionary economic cycle. Similarly, investing in portfolios that include firms with low investment, specifically those with low investment-to-assets ratios and/or low net operating assets, will also produce excess returns during a contractionary period. Finally, investing in portfolios with low trading frictions, particularly low market equity, will result in abnormal returns during a contractionary period. These same strategies and related factors generate an excess return over an entire business cycle, if held throughout the varying economic conditions (contraction, trough, and expansion).

Additionally, during the financial crisis, the only successful strategy was again, investing in firms with low investment, but more specifically those firms with low operating accruals. The other factors under the "investment strategy umbrella," investments-to-assets and net operating assets, were not successful in generating an excess return with statistical significance. Further

research must be done to find the delineating variable that partitions the investment strategy's effectiveness across economic conditions.

Finally, it's clear that during the post-financial crisis, these factors' ability to produce abnormal returns was not significant. It can be concluded that during a recovery period, these strategies are less impactful. Given the amount of uncertainty present in the markets coming out of an economic downturn, this result is not surprising.

FURTHER RESEARCH

First and foremost, my further research will revolve around: why so particular anomalies produce excess returns during varying business cycles? I intend to attempt to understand what about economic conditions in particular impact the markets, and why these various strategies' effectiveness is linked to these economic conditions. More specifically, I want to investigate whether or not it is investor behavior that guides market, especially as it relates to investor expectations. For instance, is there a link between investors' expectations and the lack of statistically significant evidence of a successful strategy during the recovery period? These are all questions that need further due diligence.

Moreover, I would also like to investigate if my results are specific to this particular business cycle. In other words, would the results change if I were to test the same factors over multiple business cycles, or would they remain the same. Similarly, I would like to understand if the overall time horizon enhances the effectiveness of these strategies.

Finally, the anomaly based on operating accruals returned a statistically significant return beyond that of the market in a single sample period, but not across the entire business cycle. This indicates that this factor was specifically impacted by the trough, or the financial crisis. That

said, it's important to recognize that this factor is related to the "investment" strategy, or the strategy that suggests that investing in firms with low investment as opposed to those with high investment will produce abnormal returns. Other factors under the umbrella of this strategy include investment-to-assets and net operating assets, which showed statistically significant evidence in producing positive abnormal returns in the contractionary period and over the entire business cycle. I intend to conduct further research to understand what separates these factors, particularly as it relates to their varying effectiveness across a business cycle. More importantly, I would like to understand the fundamental cause for the operating accruals factor's success during an economic downturn.

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